

The Amazing Newborn: Infant Behavior and Infant Brain Development



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Learning Objectives



- The participant will be able to appreciate:
 - How an early birth and the NICU can impact the developing brain and long term outcome,
 - The 6 processes of brain development,
 - The importance of infant behavior,
 - The functional behavioral differences between full term infants and preterm infants.

Infant Communication

- Infants communicate through their behavior
- Interpreter of a foreign language
- Infant behavior is very sophisticated
- Using a “system” approach to view infants
 - Autonomic
 - Motor
 - State
 - Attention/interactive
 - Self Regulation



Infant Behavior (Observable Channels)

- Organized Behaviors

- Gold standard
- Healthy term infants
- Good and to be supported
- Supports good neuro pathways
- Approach behaviors

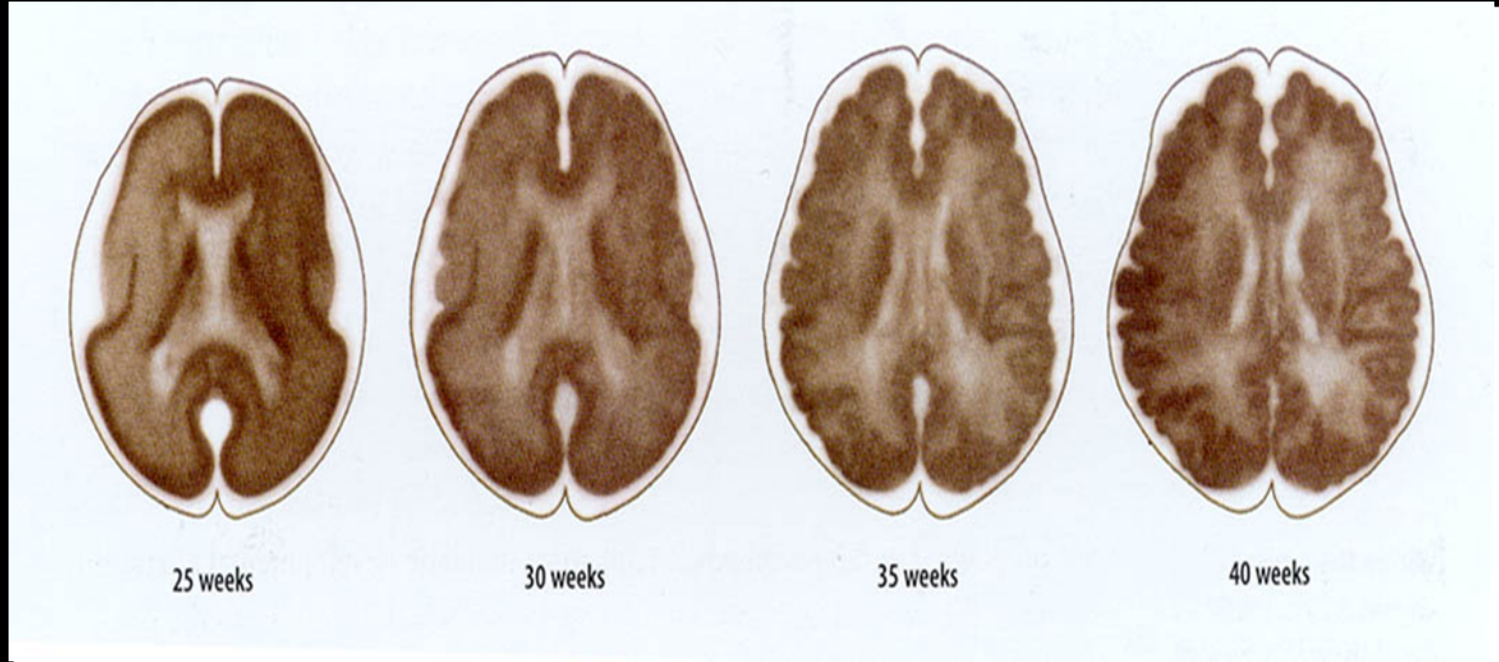
- Disorganized Behaviors

- Preterm infants
- Behaviors of Stress
- Bad and to be minimized
- Supports abnormal pathways
- Avoidance behaviors



Infant Behavior and Brain Maturation

- Infant behavior is an indicator of neurological function and brain development



The Term Newborn as a Competent Individual

- Can visually track
- Can hear and locate sounds
- Can habituate
- Can recognize mother's voice and smell
- Can discriminate mother's face from a stranger
- Can recognize emotional expressions



The Competent Preterm Infant

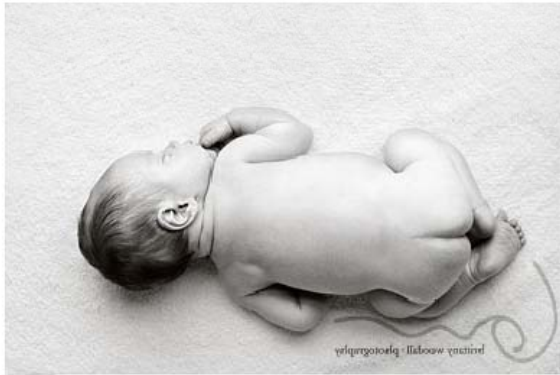
- Premature infants are NOT just small term babies!!!!
- Corrected age
- More reactive to their environments
- Easily disorganized
- Increased self-regulatory “cost”
- Need more support and facilitation from caregiver to display competent behavior



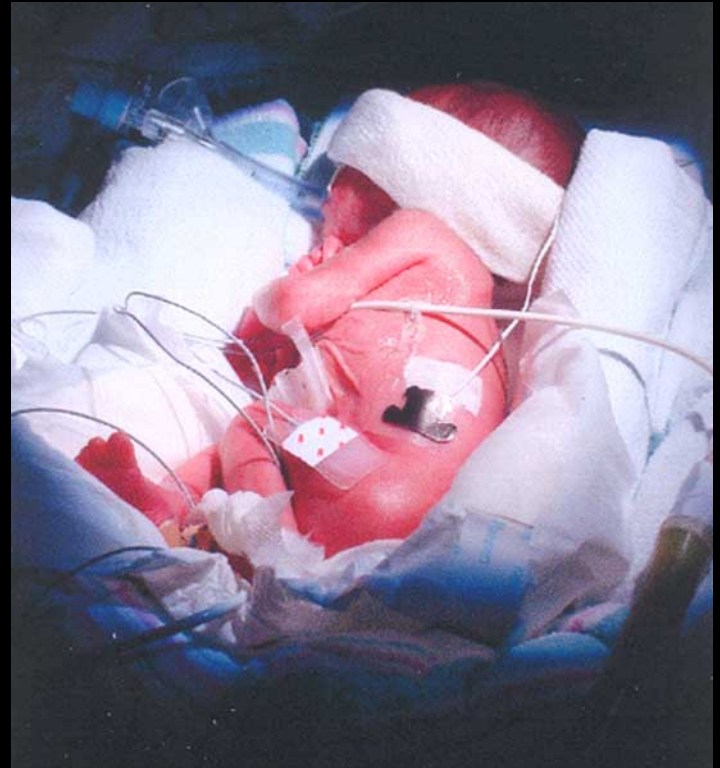
Behavioral Differences (Autonomic System)



Behavioral Differences (Motor System)



Behavioral Differences (Motor System)



Behavioral Differences (Motor System)



Behavioral Differences (Motor System)



Behavioral Differences (State System)



Behavioral Differences (State System)



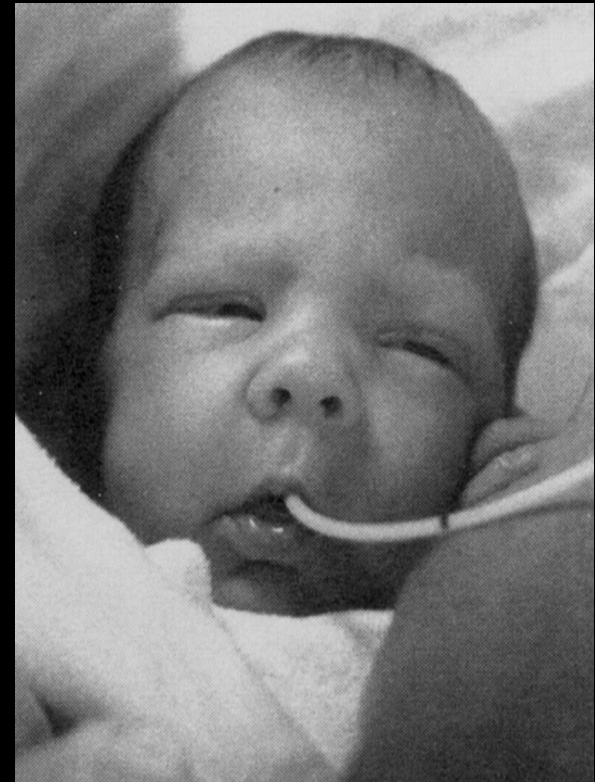
Behavioral Differences (State System)



Behavioral Differences (Attentional/interactive)



Behavioral Differences (State System)



Behavioral Differences (Self-Regulatory)



Brain Development

"He who sees things grow from the beginning will have the finest view of them"

Aristotle 384-322 B.C.



Transitions and Development

- All babies have difficulty with transitions (change)
 - Physiologic (uterus to NICU)
 - Feeding (tube to nipple)
 - Motor/posture (extension to flexion)
 - State (undefined to clear range of states/unpredictable to predictable)
 - Environment (hospital to home)
 - Infant to toddler.....



The Baby Brain

- Weighs < 1 pound at birth (term)
- Weighs 2.2 pounds at 1 year
- Close to an adult brain by 2 years



The Uniquely Human Cerebral Cortex

- Foreheads are good
- Executive portion of the brain
- 10 times larger than a monkey
- 100 times larger than a rat





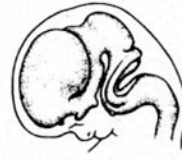
25 DAYS



35 DAYS



40 DAYS

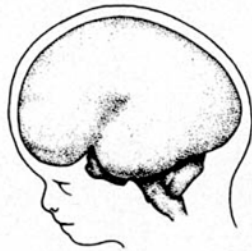


50 DAYS

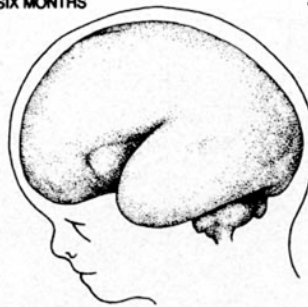


100 DAYS

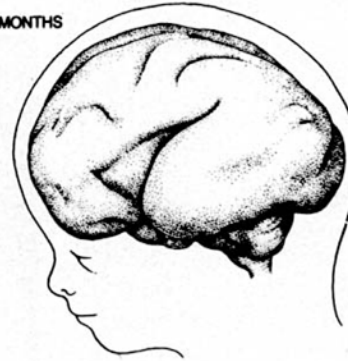
FIVE MONTHS



SIX MONTHS



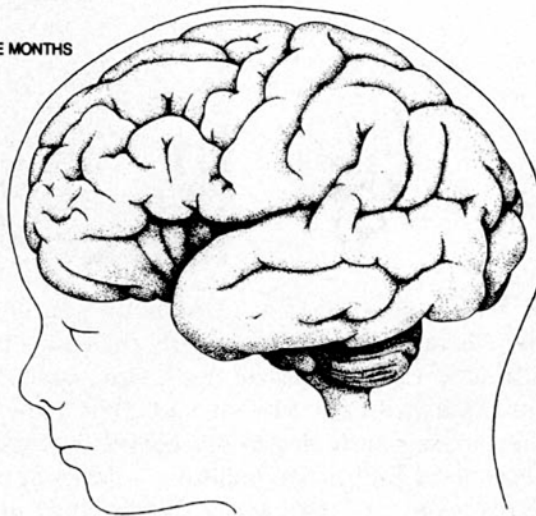
SEVEN MONTHS



EIGHT MONTHS

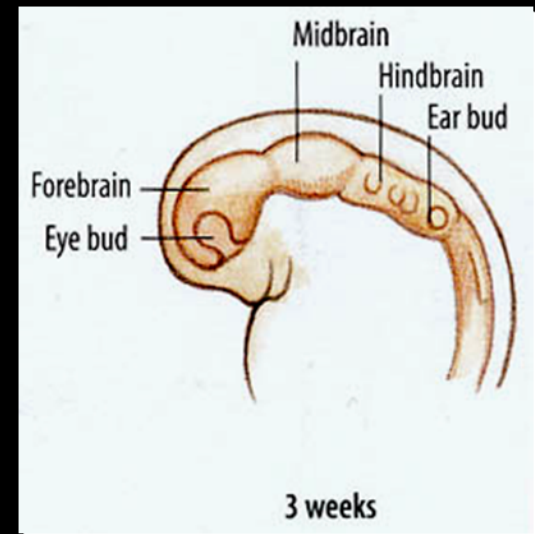
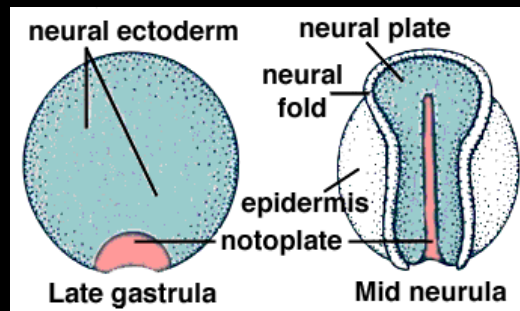


NINE MONTHS



Dorsal Induction (4-6 weeks)

- Normal Development:
 - Formation of the neural tube
- Errors in Development
 - Anencephaly
 - Encephalocele
 - Meningomyelocele



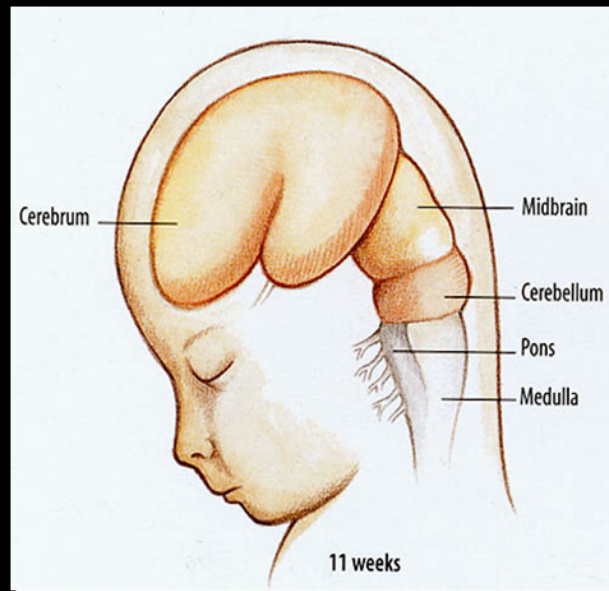
Ventral Induction (2-3 months)

- Normal Development:

- Face and forebrain
- Separation of the cerebral hemispheres

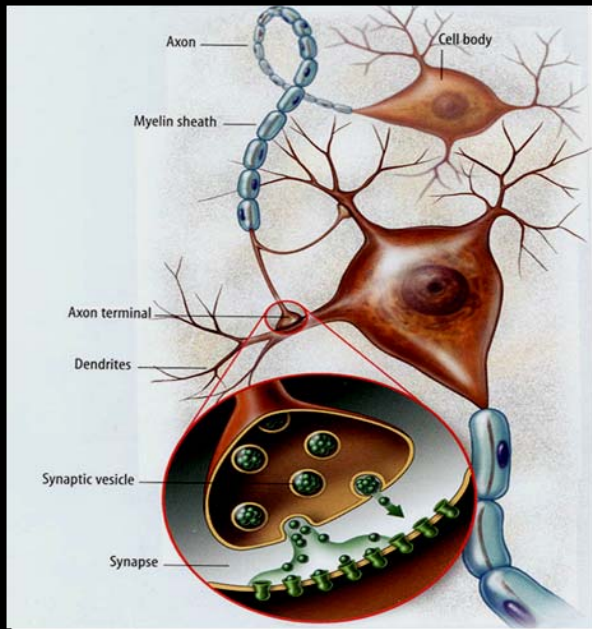
- Errors in Development:

- Holoprosencephaly
- Midline defects
- Associated with chromosomal disorders



Neuronal Proliferation (2-4 months)

- Normal Development:
 - Production of neurons

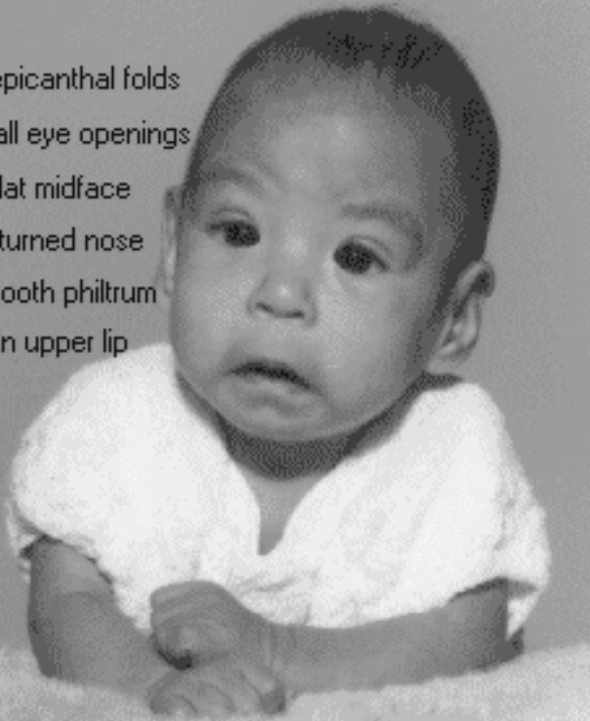


- Errors in Development:
 - Teratogens
 - Microcephaly
 - Macrocephaly

Fetal Alcohol Syndrome

FAS Facial Characteristics

epicanthal folds
small eye openings
flat midface
upturned nose
smooth philtrum
thin upper lip



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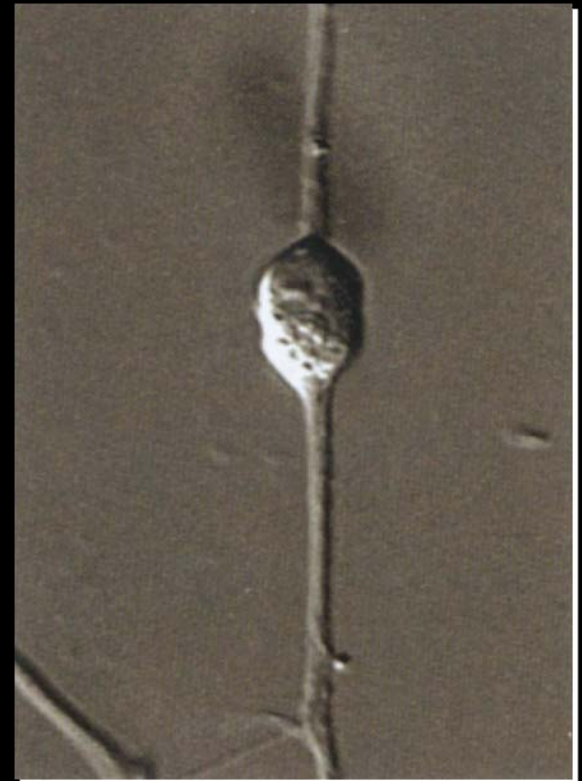
6-Week Old Baby
"Normal" brain



6-Week Old Baby
"Fetal Alcohol Syndrome" brain

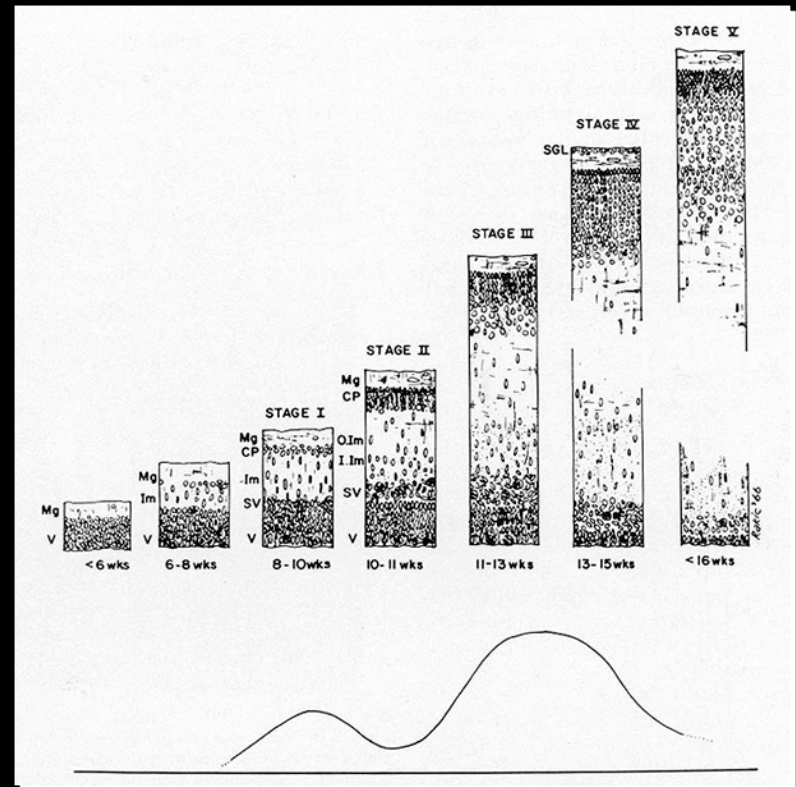
Neuronal Migration (3-5 months)

- Normal Development:
 - Neurons migrating to the cortex
- Errors in Development:
 - Lissencephaly
 - Schizencephaly
 - Agenesis of the Corpus Collosum



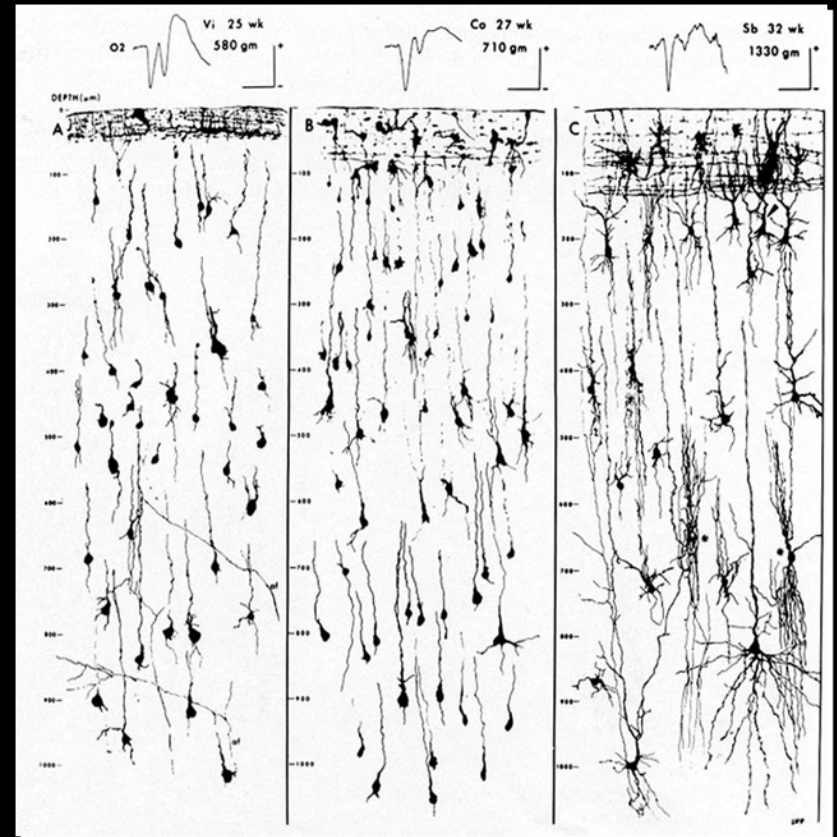
Organization (6 months-years postnatal)

- Normal Development:
 - “Hard wiring”
 - Alignment, and layering of the cortex (6 layers)
- Errors in Development:
 - Primary errors
 - Mental retardation
 - Downs Syndrome
 - Potential errors
 - Prematurity/NICU
 - Perinatal insults

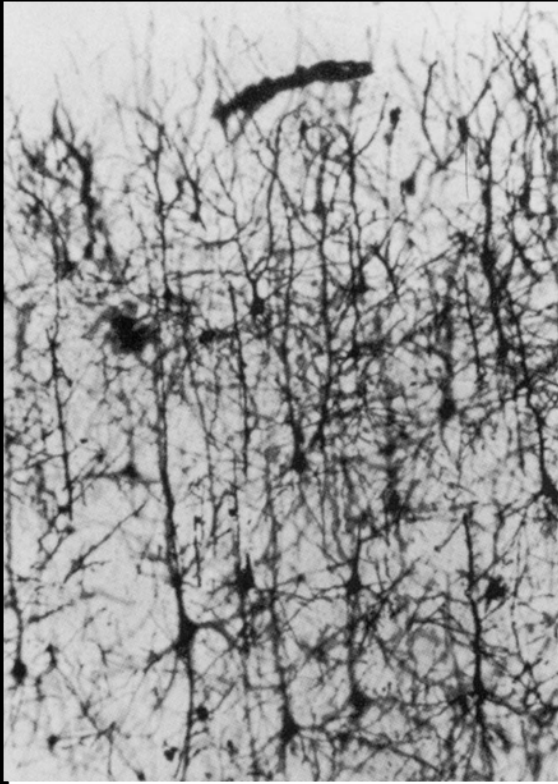


Establishment of Synaptic Connections

- The circuitry of dendrites approaches completeness around the 28th to 36th week gestation
- Accounts for the functional differences in behavior



Differences in Organizational Processes



Potential Disturbances in Organization

- Impact of the NICU experience

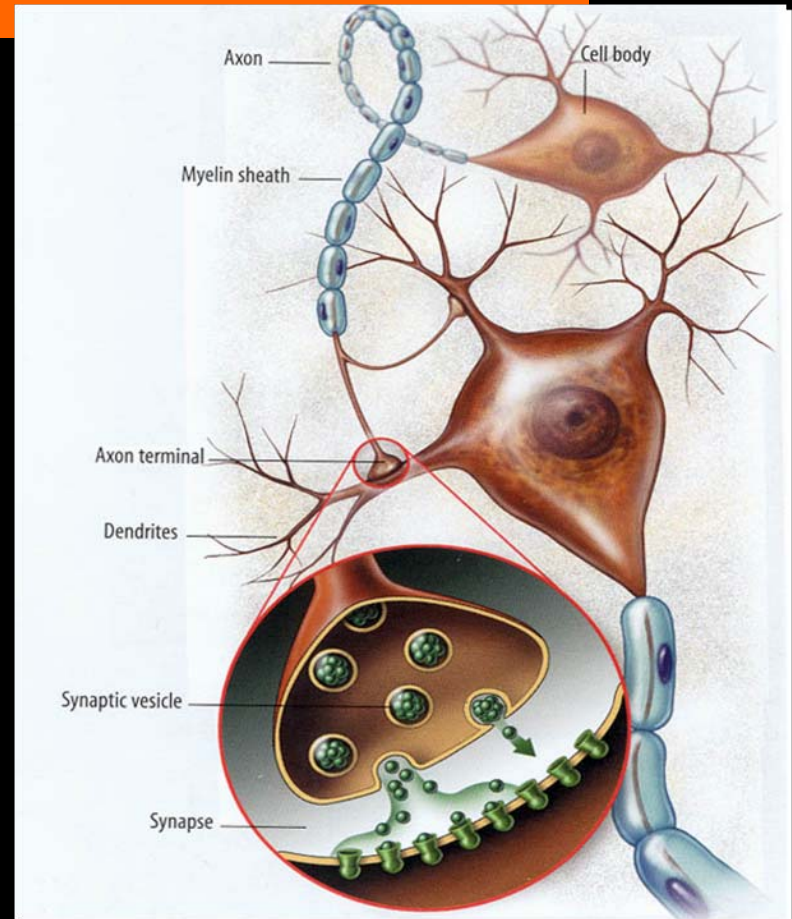
and/or

- The effects of frequent insults to the developing human brain in the perinatal period



Myelination (Birth at term to years postnatal)

- Normal Development:
 - Insulates the circuitry
 - Enhances cellular communication
- Errors in Development:
 - Prematurity
 - Perinatal Insults
 - Poor nutrition
 - Cerebral White Matter Hypoplasia



Developmental Processes



Experience Expectant

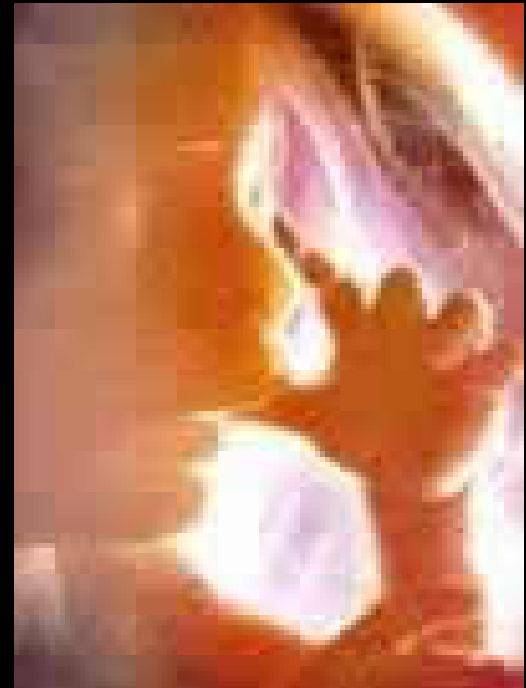
Experience Dependent



**“What they do” becomes “who they
are.....”** (Laura Robison)



The NICU or the Womb?





“A portion of overall morbidity among VLBW infants may represent injury to the developing brain resulting from the stressful nature of the NICU”

(Cornell and Gottfried, 1976; Duffy, Mower, Jenson and Als, 1984)

What is Developmental Care?

- Developmental Care is a philosophy of care that integrates the developmental needs of each individual infant in the NICU within the frame work of medical and nursing care.



Key Concepts of Developmental Care

- Promoting organized infant neurobehavior and physiological function
- Providing a physical environment that supports growth, development and recovery
- Understanding infant behavior and letting that behavior guide our care
- Supporting Family Centered Care

Celebrating Competent and Organized Behavior



Parent-Infant Relationships are Supported From Birth

- Infants are primarily social beings
- All development happens within the context of a social interaction
- “A baby alone does not exist”

(Donald Winnicott, 1965)

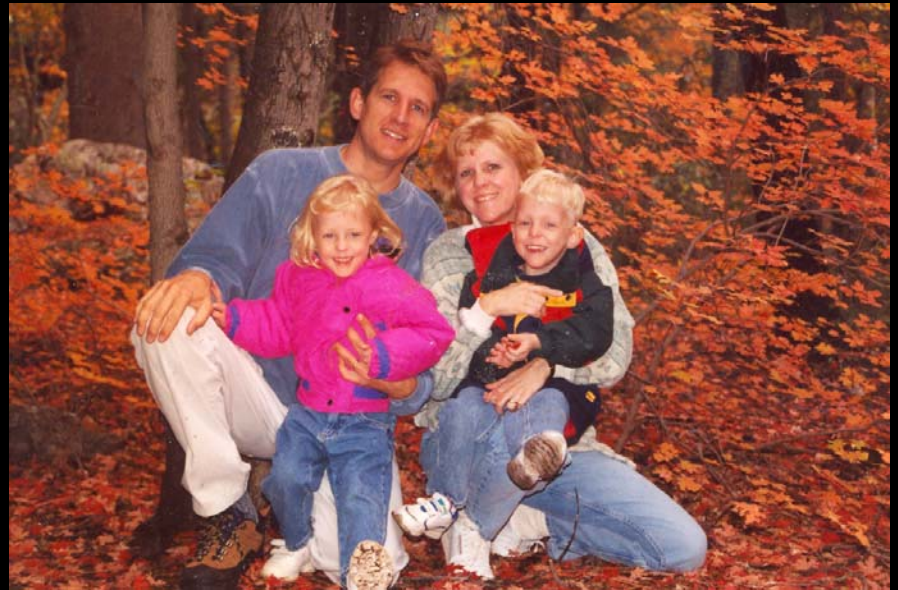


Kangaroo Care



Co-Bedding





“Each infant has one brain for life... Everything matters.”

(Dr. Als, Developmental Interventions, Chicago, 1997)



Why We Do What We Do!



At Discharge from the NICU: Which way will it go?



Major Neurodevelopmental Disabilities of the VLBW

- Cerebral Palsy (spastic diplegia)
- Cognitive Impairment
- Sensorineural Hearing Loss
- Visual Impairment
- Progressive Hydrocephalus

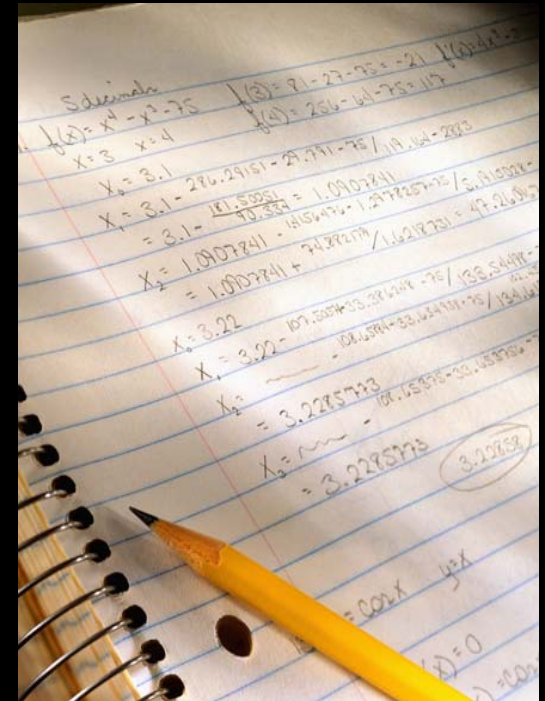


Major Sequelae by Age 5

	No major disability	1 or more major disability
1500-2500 grams	90%	10%
1000-1500 grams	80%	20%
< 1000 grams	70%	30%

Minor Neurodevelopmental Disabilities

- Neurobehavioral problems
- Temperament
- Language delay
- Poor motor coordination
- Socio-emotional immaturity
- Learning/behavioral problems
- School dysfunction



Minor Neurodevelopmental Disabilities: The New Morbidity

- Up to 50% of premature infants may have:
 - Behavioral disorganization
 - Attention disorders
 - Maladaptive behavioral patterns for coping (self-regulation)
 - School dysfunction
- “Can’t hold their own in a 2nd grade class room”-Dr. Als



Outcome at School Age (Granau, et al, 1999)

	ELBW	Term
Learning Disability	65%	13%
Reading	33%	3%
Math	30%	7%
Written output	54%	7%
Poor Coordination	51%	6%

Bottom Line

- Infants have meaningful behavior
- Their experience in life colors their brain development
- One brain for life.....
- Development is dependant on social interactions
- Importance of the first 3 years



Questions?

